IN THE MATTER OF
Patent Application of
HONDA MOTOR CO., LTD.

I, Nobuko SUDA, 17-23 Fukasawa 6-chome, Setagaya-ku, Tokyo 158-0081, Japan, do hereby declare that I am conversant with the Japanese and English languages and am a competent translator thereof. I further declare that to the best of my knowledge and belief, the following is a true and correct translation, made by me, of the official copy of the document in respect of a Patent Application No. 2003-062047 filed in Japan on March 7, 2003.

Signed this 3rd day of July, 2007

By N S Suda
Nobuko SUDA

(Translation)

JAPAN PATENT OFFICE

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Date of Application:	March 7, 2003
Application Number:	Patent Application No. 2003-062047
Applicant(s):	HONDA MOTOR CO., LTD.

December 24, 2003

Commissioner,
Japan Patent Office

Yasuo IMAI (Seal)
(Certificate No. 2003-3106937)

[Document Name] Patent Application

[Reference Number] PCB17315HT

[Date of Submission] March 7, 2003

[To] The Commissioner of the Patent Office

[International Patent Classification] H01M 8/02
H01M 8/10

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[Indication of Fees]

[Prepayment Register Number]	001834
[Amount of Payment]	21000

[List of the Attached Documents]

[Document Name]	Specification	1
[Document Name]	Drawings	1
[Document Name]	Abstract	1
[General Power of Attorney Number]	9711295	
[General Power of Attorney Number]	0206309	

[Proof] Necessary

(2003-062047)

Applicant's History Information

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1. Date of Change	September 6, 1990
[Reason for Change]	New Registration
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(2003-062047)

[DOCUMENT NAME] Specification

[TITLE OF THE INVENTION]

FUEL CELL STACK

[CLAIMS]

[Claim 1]

A fuel cell stack comprising a plurality of cell units, said cell units each including a plurality of power generation units arranged in a same plane and a pair of electrically insulating separators for sandwiching said power generation units, said power generation units each including an anode, a cathode and an electrolyte interposed between said anode and said cathode, said fuel cell stack further comprising:

a casing containing said cell units,

wherein a plurality of guide grooves are formed on at least one of said separators on a surface opposite to a surface facing said power generation units, for supplying a coolant along said separator; and

a coolant passage is connected to said guide grooves of each of said cell units in said casing.

[Claim 2]

A fuel cell stack according to claim 1,

wherein a reactant gas supply passage and a reactant gas discharge passage extend through said cell units in a stacking direction of said cell units, and said fuel cell stack further comprises a seal member for separating said

reactant gas supply passage and said reactant gas discharge passage from said coolant passage.

[DETAILED EXPLANATION OF THE INVENTION]

[0001]

[TECHNICAL FIELD TO WHICH THE INVENTION PERTAINS]

The present invention relates to a cell unit having a plurality of power generation units arranged in a same plane. Each of the power generation units includes an anode, a cathode, and an electrolyte interposed between the anode and the cathode.

[0002]

[PRIOR ART]

Generally, a solid polymer electrolyte fuel cell employs a membrane electrode assembly (MEA) which includes two electrodes (anode and cathode), and an electrolyte membrane interposed between the electrodes. Each of the electrodes comprises an electrode catalyst layer of noble metal supported on a carbon base material. The electrolyte membrane is a polymer ion exchange membrane (cation exchange membrane). The membrane electrode assembly is a power generation unit interposed between separators (bipolar plates). The membrane electrode assembly and the separators make up a unit of a fuel cell (cell unit) for generating electricity. A predetermined number of the cell units are stacked together to form a fuel cell stack.

[0003]

In the fuel cell, a fuel gas (reactant gas) such as a

gas chiefly containing hydrogen (hydrogen-containing gas) is supplied to the anode. The catalyst of the anode induces a chemical reaction of the fuel gas to split the hydrogen molecule into hydrogen ions (protons) and electrons. The hydrogen ions move toward the cathode through the electrolyte, and the electrons flow through an external circuit to the cathode, creating a DC electric current. A gas chiefly containing oxygen (oxygen-containing gas) or air is supplied to the cathode. At the cathode, the hydrogen ions from the anode combine with the electrons and oxygen to produce water.

[0004]

For example, Patent Document 1 discloses another flat fuel cell in which a plurality of cell units are arranged in the same plane in a single row, or a plurality of rows. The cell units are electrically connected in series. FIG. 7 shows the flat fuel cell. The flat fuel cell includes cell units 4a through 4d. Air electrodes (cathodes) 2a through 2d and fuel electrodes (anodes) 3a through 3d are provided on both sides of electrolyte layers 1a through 1d. The same electrodes are arranged on the same side of the electrolyte layers 1a through 1d, i.e., the cathodes 2a through 2d are arranged on one side of the electrolyte layers 1a through 1d, and the anodes 3a through 3d are arranged on the other side of the electrolyte layers 1a through 1d. Conductive Z-like connection plates 5a through 5d connect the cell units 4a through 4d together in series.

[0005]

Specifically, the conductive Z-like connection plate 5a connects the cathode 2a of the cell unit 4a and the anode 3b of the cell unit 4b, the conductive Z-like connection plate 5b connects the cathode 2b of the cell unit 4b and the anode 3c of the cell unit 4c, and the conductive Z-like connection plate 5c connects the cathode 2c of the cell unit 4c and the anode 3d of the cell unit 4d. The anode 3a of the cell unit 4a is connected to a terminal 6a, and the cathode 2d of the cell unit 3d is connected to a terminal 6b.

[0006]

[Patent Document]

Japanese Laid-Open Patent Publication No. 2002-56855 (FIG. 1)

[0007]

[TASK TO BE SOLVED BY THE INVENTION]

If the fuel cell stack is mounted on a vehicle, two hundreds to six hundreds of cell units are required to form the fuel cell stack for generating the desired level of voltage and current for driving the vehicle. In Patent Document 1, preferably, a plurality of the flat cell units may be connected in series for generating a high level of voltage.

[0008]

When the cell units are stacked together for generating a large electrical energy at a high voltage, the excessive heat generation of the cell units may affect the performance

of the fuel cell stack. Therefore, it is essential to use a liquid cooling system for effectively cooling the cell units. However, Patent Document 1 merely discloses a fuel cell operated at a small voltage. No solutions using such a cooling system are suggested in the disclosure.

[0009]

A main object of the present invention is to provide a fuel cell stack having a simple and compact structure in which a plurality of power generation units are arranged in the same plane to form a cell unit for producing a large output (a large amount of electricity), while the power generating units are suitably cooled.

[0010]

[SOLUTION FOR THE TASK]

According to the cell unit stack recited in claim 1 of the present invention, a plurality of power generation units are arranged in a same plane. Each of the power generation unit includes an anode, a cathode, and an electrolyte interposed between the anode and the cathode. A plurality of the cell units are disposed in a casing.

[0011]

The power generation units are sandwiched between a pair of electrically insulating separators to form a cell unit. A plurality of guide grooves are formed on at least one of the separators on a surface opposite to a surface facing the power generation units, for supplying a coolant along the separator. A coolant flow field is connected to

the guide grooves of each of the cell units in the casing.

[0012]

Electrically insulating separators are used instead of metal separators. Therefore, the separators can be produced easily at a low cost. The electrically insulating separator has the guide grooves as passage of the coolant. The guide grooves are electrically insulated desirably. Since the guide grooves are insulated, leakage of electricity to the liquid or the ground is reliably prevented. Consequently, special coolant for the cell unit or dedicated devices for preventing the leakage of electricity to the liquid such as an ion exchanger are not required. The cooling system is simple, and produced or operated at a low cost. No periodical maintenance operations are required.

[0013]

It is not required to use pure water having high insulation properties but easily freezing at a below-freezing temperature. Thus, it is not required to use alcohol or like which does not freeze easily. The oxidation of the solid polymer electrolyte membrane is prevented, and elusion of ions form system components can be prevented without any special devices.

[0014]

The guide grooves are formed along the surface of the second separator to increase the surface area of the second separator, and thus, to improve the cooling efficiency. When the electrically insulating separators of the adjacent

cell units are in contact with each other, the guide grooves are formed between the electrically insulating separators. Thus, when an impact such as vibration is applied to the casing, since the separators are in contact with each other, the separators do not rattle, and the cell units are not damaged easily by the impact.

[0015]

It is not necessary to provide dedicated cooling structure in each of the cell units, and it is not necessary to place each of the cell units in a dedicated container. The number of components of the fuel cell stack is small. Therefore, the cell unit is simple, and small. The cell units can be replaced individually, and handled with ease.

[0016]

In the fuel cell stack recited in claim 2, a reactant gas supply passage and a reactant gas discharge passage extend through the cell units in a stacking direction of the cell units, and the fuel cell stack further comprises a seal member for separating the reactant gas supply passage and the reactant gas discharge passage from the coolant passage. With the simple structure, leakage of the reactant gases and the coolant is prevented reliably.

[0017]

[MODE FOR CARRYING OUT THE INVENTION]

FIG. 1 is a schematic perspective view showing a fuel cell stack 10 according to an embodiment of the present invention.

[0018]

The fuel cell stack 10 includes a casing 12 which accommodates a plurality of cell units 14 stacked in a direction indicated by the arrow A. As shown in FIGS. 2 and 3, the cell units 14 comprises an MEA (membrane electrode assembly) unit 16, and first and second separators 17a, 17b provided on both surfaces of the MEA unit 16.

[0019]

At a corner of the cell unit 14 in directions indicated by arrows B and C, a fuel gas supply passage 18a for supplying a fuel gas such as a hydrogen-containing gas, and an oxygen-containing gas supply passage 20a for supplying an oxygen-containing gas are formed adjacent to each other. The fuel gas supply passage 18a and the oxygen-containing gas supply passage 20a extend through the cell unit 14 in a direction indicated by an arrow A. Further, at another corner of the cell unit 14 in the directions indicated by the arrows B and C, a fuel gas discharge passage 18b for discharging the fuel gas, and an oxygen-containing gas discharge passage 20b for discharging the oxygen-containing gas are formed adjacent to each other. The fuel gas discharge passage 18b and the oxygen-containing gas discharge passage 20b extend through the cell unit 14 in the direction indicated by the arrow A.

[0020]

The MEA unit 16 includes a solid polymer electrolyte membrane 22 formed by impregnating a thin membrane of

perfluorosulfonic acid with water, for example. The solid polymer electrolyte membrane 22 is a common electrolyte for making up a plurality of membrane electrode assemblies (power generation units) 24(1) through 24(n). As shown in FIG. 2, a predetermined number of the membrane electrode assemblies 24(1) through 24(n) are arranged in directions indicated by the arrows B and C in a plane of the solid polymer electrolyte membrane 22.

[0021]

As shown in FIG. 3, reinforcing films (e.g., silicon films) 26a, 26b are formed on both surfaces 22a, 22b of the solid polymer electrolyte membrane 22 around portions for providing the electrodes as described later. In the solid polymer electrolyte membrane 22, a plurality of holes 27 are formed at the predetermined positions (see FIG. 2).

[0022]

The membrane electrode assembly 24(1) includes a cathode 28 on one surface 22a of the solid polymer electrolyte membrane 22, and an anode 30 on the other surface 22b of the solid polymer electrolyte membrane 22. Each of the anode 30 and the cathode 28 is formed by coating the surface 22a, 22b with porous carbon particles which support platinum alloy. The cathode 28 includes a first electrically conductive diffusion layer 32, and the anode 30 includes a second electrically conductive diffusion layer 34.

[0023]

The membrane electrode assemblies 24(2) through 24 (n) have the same structure as the membrane electrode assembly 24(1). The constituent elements that are identical to those of the membrane electrode assembly 24(1) are labeled with the same reference numeral, and description thereof will be omitted.

[0024]

As shown in FIGS. 4 and 5, the first electrically conductive diffusion layer 32 of the membrane electrode assembly 24(1) has a first end 32a extending toward the adjacent membrane electrode assembly 24(2). The second electrically conductive diffusion layer 34 of the membrane electrode assembly 24(2) has a second 34a end extending toward the adjacent membrane electrode assembly 24(1).

[0025]

The first and second ends 32a, 34a partially overlap such that the solid polymer electrolyte membrane 22 and the silicon films 26a, 26b are interposed between overlapping portions of the first and second ends 32a, 34a. The overlapping portions are electrically connected with each other by an electrically conductive rivet member 36. A seal member 38 is formed around the outer surface of the rivet member 36 for sealing both surfaces of the solid polymer electrolyte membrane 22 hermetically. Flanges 36a, 36b protruding toward the first end 32a and the second end 34a are formed by squeezing the rivet member 36.

[0026]

As shown in FIGS. 3 and 5, the first electrically conductive layer 32 of the membrane electrode assembly 24(2) has a first end 32a extending toward the adjacent membrane electrode assembly 24(3). The second electrically conductive diffusion layer 34 of the membrane electrode assembly 24(3) has a second end 34a extending toward the adjacent membrane electrode assembly 24(2). The overlapping portions of the first and second ends 32a, 34a are electrically connected by the rivet member 36. Likewise, the membrane electrode assemblies 24(3) through 24(n) are electrically connected in series.

[0027]

The first and second separators 17a, 17b are made of insulating, and thermally conductive material such as reinforced plastic. As shown in FIGS. 2 and 6, the first separator 17a has a supply manifold 40 and a discharge manifold 42 on its surface 39a facing the MEA unit 16. The supply manifold 40 is formed on one side in the direction indicated by the arrow C, and the discharge manifold 42 is formed on the other side in the direction indicated by the arrow C. The supply manifold 40 and the discharge manifold 42 extend in the direction indicated by the arrow B. The supply manifold 40 includes a groove connected to the fuel gas supply passage 18a. The discharge manifold 42 includes a groove connected to the fuel gas discharge passage 18b.

[0028]

A fuel gas flow field 44 is formed between the supply

manifold 40 and the discharge manifold 42 for supplying the fuel gas to the anodes 30 of the MEA unit 16. The fuel gas flow field 44 includes a plurality of flow grooves extending in the direction indicated by the arrow C between the supply manifold 40 and the discharge manifold 42. Rectangular recesses 46 for providing the anodes 30 of the membrane electrode assemblies 24(1) through 24(n) are formed on the surface 39a. Further, a plurality of threaded holes 48 are formed at predetermined positions on the surface 39a.

[0029]

A seal 50 is formed around the fuel gas supply passage 18a, the fuel gas discharge passage 18b, the supply manifold 40, the discharge manifold 42, and the fuel gas flow field 44 by heat treatment, for example. The first separator 17a has a negative terminal 52 which is connectable to the anode 30 of the membrane electrode assembly 24(1). The seal member 53a extends along the entire width in the direction indicated by the arrow C on the surface 39b opposite to the surface 39a, and extends along both side surfaces of the first separator 17a. The seal member 53a is provided adjacent to the fuel gas supply passage 18a, the oxygen-containing gas supply passage 20a, the oxygen-containing gas discharge passage 20b, and the fuel gas discharge passage 18b for preventing leakage from the coolant passage as described later.

[0030]

As shown in FIG. 7, the second separator 17b has a

supply manifold 54 and a discharge manifold 56 on its surface 16a facing the MEA unit 16. The supply manifold 54 is connected to the oxygen-containing gas supply passage 20a, and extends in the direction indicated by the arrow B. The discharge manifold 56 is connected to the oxygen-containing gas discharge passage 20b, and extends in the direction indicated by the arrow B. The supply manifold 54 and the discharge manifold 56 are connected by an oxygen-containing gas flow field 58. The oxygen-containing gas flow field 58 includes a plurality of flow grooves extending in the direction indicated by the arrow C.

[0031]

A seal 50 is formed around the oxygen-containing gas supply passage 20a, the oxygen-containing gas discharge passage 20b, the supply manifold 54, the discharge manifold 56, and the oxygen-containing gas flow field 58 by heat treatment, for example.

[0032]

Rectangular recesses 60 corresponding to the cathodes 28 of the membrane electrode assemblies 24(1) through 24 (n) are formed on the surface 16a. Seal-attached Holes 62 are formed at predetermined positions on the surface 16a. As shown in FIG. 1, tightening screws 64 are inserted through the seal-attached holes 62, and the holes 27 of the MEA unit 16, and screwed into the seal-attached threaded holes 48 of the first separator 17a for tightening the components of the cell unit 14 together. The second separator 17b has a

positive terminal 66 which is connectable to the cathode 28 of the membrane electrode assembly 24(n).

[0033]

As shown in FIG. 2, the second separator 17b has ribs 70 extending in the direction indicated by the arrow C on its surface 55b opposite to the surface 55a. A guide groove 72 for flowing the coolant is formed between the ribs 70 along the surface of the separator 17b.

[0034]

A seal member 53b is attached to the second separator 17b. The seal member 53b is provided adjacent to the fuel gas supply passage 18a, the oxygen-containing gas supply passage 20a, the oxygen-containing gas discharge passage 20b, and the fuel gas discharge passage 18b. The seal member 53b extends along the entire width in the direction indicated by the arrow C on the surface 55b, and along both side surfaces of the second separator 17b. When the first and second separators 17a, 17b are stacked together, the seal members 53a, 53b jointly forms seal structure wound around the cell unit 14.

[0035]

The casing 12 is made of resin, and has aluminum outer plates. As shown in FIG. 1, a stack of the cell units 14 are provided in a chamber 12a. Further, a coolant supply passage 74a and a coolant supply passage 74b connected to guide grooves 72 of the cell units 14 are provided in the chamber 12a.

[0036]

As shown in FIGS. 1 and 8, the coolant supply passage 74a is formed between an inner wall of the casing 12 and end surfaces of the cell units 14 in a direction indicated by the arrow C1 and the coolant discharge passage 74b is formed between the inner surface of the casing 12 and end surfaces of the cell units 14 in the other direction indicated by the arrow C2. A coolant inlet 76a is formed at a bottom surface of the casing 12. The coolant inlet 76a is connected to an end of the coolant supply passage 74a at one end in the direction indicated by the arrow C1. A coolant outlet 76b is formed at a top surface of the casing 12. The coolant outlet 76b is connected to the coolant discharge passage 216 at the other end in the direction indicated by the arrow C2.

[0037]

As shown in FIG. 1, the cell units 14 are stacked in the direction indicated by the arrow A. Thus, the seal members 53a, 53b of the cell units 14 are stacked together, and the interior of the chamber 12 is separated into the chamber 12a and the reactant gas chamber 12b. A casing cover 78 covers the reactant gas chamber 12b.

[0038]

As shown in FIG. 9, spacers 80a, 80b for connecting gas passages are formed between the cell units 14. The spacer 80a has the fuel gas supply passage 18a and the oxygen-containing gas supply passage 20a, and the spacer 80b has the oxygen-containing gas discharge passage 20b and the fuel

gas discharge passage 18b (see FIG. 2).

[0039]

Terminals 52 of the cell units 14 are connected together tightly by a terminal tightening bolt 82a. Terminals 66 of the cell units 14 are connected together tightly by a terminal tightening bolt 82b.

[0040]

Next, operation of producing the fuel cell stack 10 will be described.

[0041]

Firstly, as shown in FIG. 2, tightening screws 64 are inserted into the holes 62 when the MEA unit 16 is interposed between the first and second separators 17a, 17b. The ends of the tightening screws 64 are screwed into the threaded holes 48. Thus, the first separator 17a, the MEA unit 16, and the second separator 17b are tightened together to form one cell unit 14.

[0042]

The cell units 14 are stacked in the direction indicated by the arrow A, and the spacers 80a, 80b are interposed between the cell units 14. After a predetermine number of the cell units 14 are stacked together, the terminal bolts 224a, 224b are inserted into the terminals 52, 66 for tightening the terminals 52, 66 together. As shown in FIG. 1, the stack of the cell units 14 is disposed in the casing 12 such that the seal members 53a, 53b of the cell units 14 are tightly in contact with each other. The

chamber 12a and the reactant gas chamber 12b are separated in the casing 12.

[0043]

The stack of the cell units 14 is disposed in the chamber 12a. The coolant inlet 76a is connected to the coolant supply passage 74a, and the coolant outlet 76b is connected to the coolant discharge passage 74b. The coolant supply passage 74a and the coolant discharge passage 74b are connected to the guide grooves 72 of the cell units 14.

[0044]

Next, operation of the cell unit 14 will be described.

[0045]

Firstly, referring to FIG. 1, in the casing 12, an oxygen-containing gas is supplied to the oxygen-containing gas supply passage 20a and a fuel gas such as a hydrogen containing gas is supplied to the fuel gas supply passage 18a. Further, a coolant such as pure water, an ethylene glycol or an oil is supplied to the coolant flow fields 72.

[0046]

Specifically, as shown in FIG. 7, the oxygen-containing gas flows into the supply manifold 54 on the surface 16a of the second separator 17b. Then, the oxygen-containing gas is supplied into the oxygen-containing gas flow field 58. The oxygen-containing gas flows through the flow grooves of the oxygen-containing gas flow field 58 in the direction indicated by the arrow C along the cathodes 28 of the membrane electrode assemblies 24(1) through 24(n) for

inducing a chemical reaction at the cathodes 28. After the oxygen in the oxygen-containing gas is partially consumed, the oxygen-containing gas is discharged into the oxygen-containing gas discharge passage 20b through the discharge manifold 56.

[0047]

Likewise, as shown in FIG. 6, the fuel gas flows into the fuel gas manifold 40 on the surface 39a of the first separator 17a. Then, the fuel gas is supplied into the fuel gas flow field 44 connected to the supply manifold 40. The fuel gas flows through the flow grooves of the fuel gas flow field 44 in the direction indicated by the arrow C along the anodes 30 of the membrane electrode assemblies 24(1) through 24(n) for inducing a chemical reaction at the anodes 30.

[0048]

Thus, in the membrane electrode assemblies 24(1) through 24(n), the oxygen-containing gas supplied to the cathodes 28, and the fuel gas supplied to the anodes 30 are consumed in the electrochemical reactions at catalyst layers of the cathodes 28 and the anodes 30 for generating electricity. All of the power generation units, i.e., the membrane electrode assemblies 24(1) through 24(n) are electrically connected in series between the terminals 52, 66 for outputting a desired level of voltage.

[0049]

In this embodiment, each of the cell units 14 includes the MEA unit 16, and the first and second separators 17a,

17b sandwiching the MEA unit 16. The first and second separators 17a, 17b are electrically insulating separators 17a, 17b. In contrast to the metal separators, the first and second insulating separators 17a, 17b are produced easily at a low cost.

[0050]

The second separator 17b has the guide grooves 72 as passages of the coolant. The guide grooves 72 are electrically insulated desirably. Since the guide grooves are insulated, leakage of electricity to the liquid or the ground is reliably prevented. Consequently, special coolant for the fuel cell or dedicated devices such as an ion exchanger for preventing the leakage of the electricity to the liquid is not required. The cooling system is simple, and produced or operated at a low cost.

[0051]

Since it is not required to use pure water easily freezing at a below-freezing temperature, it is also not required to use alcohol or like which does not freeze easily. The oxidation of the solid polymer electrolyte membrane 122 is prevented, and elusion of ions can be prevented without any special devices.

[0052]

The guide grooves 72 are formed along the surface of the second separator 17b to increase the surface area of the second separator 17b, and thus, to improve the cooling efficiency. The first separator 17a of one cell unit 14 is

in contact with the second separator 17b of the adjacent cell unit 14, and the guide grooves 72 for supplying the coolant are formed between the first and second separators 17a, 17b. When an impact such as vibration is applied to the casing 12, since the first and second separators 17a, 17b, are in contact with each other, the first and second separators 17a, 17b do not rattle, and the cell units 14 is not damaged easily by the impact.

[0053]

In this embodiment, a predetermined number of the cell units 14 are stacked in the casing 12. The coolant supply passage 74a or the coolant discharge passage 74b is formed between the end surfaces of the cell units 14 and the inner surface of the casing 12. Thus, it is not necessary to provide dedicated cooling structure in each of the cell units 14, and it is not necessary to place each of the cell units 14 in a dedicated container. The number of components of the fuel cell stack 10 is small. The cell unit 14 is simple, and small. The cell units 14 can be replaced individually, and handled with ease.

[0054]

[EFFECT OF THE INVENTION]

According to the fuel cell stack of the present invention, the electrically insulating separator has the guide grooves as passage of the coolant. The guide grooves are electrically insulated desirably. Since the guide grooves are insulated, leakage of electricity to the liquid

or the ground is reliably prevented. Consequently, special coolant for the cell unit or dedicated devices for preventing the leakage of the electricity to the liquid such as an ion exchanger are not required. The cooling system is simple, and produced or operated at a low cost. No periodical maintenance operations are required.

[0055]

It is not required to use alcohol or like which does not freeze easily. The oxidation of the solid polymer electrolyte membrane is prevented, and elusion of ions form system components can be prevented without any special devices.

[0056]

The guide grooves are formed along the surface of the second separator to increase the surface area of the second separator, and thus, to improve the cooling efficiency. It is not necessary to provide dedicated cooling structure in each of the cell units, and it is not necessary to place each of the cell units in a dedicated container. The number of components of the fuel cell stack is small. Therefore, the cell unit is simple, and small. The cell units can be replaced individually, and handled with ease.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[FIG. 1]

FIG. 1 is a schematic view of a fuel cell stack according to an embodiment of the present invention.

[FIG. 2]

FIG. 2 is an exploded perspective view showing main components of a cell unit in the embodiment of the present invention.

[FIG. 3]

FIG. 3 is a cross sectional view showing main components of the cell unit.

[FIG. 4]

FIG. 4 is a view showing connection state in an MEA unit of the cell unit.

[FIG. 5]

FIG. 5 is a front view showing the MEA unit.

[FIG. 6]

FIG. 6 is a front view showing a first separator of the fuel cell.

[FIG. 7]

FIG. 7 is a front view showing a second separator of the fuel cell.

[FIG. 8]

FIG. 8 is a view showing a coolant supply passage and a coolant discharge passage of the fuel cell stack.

[FIG. 9]

FIG. 9 is a perspective view showing a part of the stacked cell unit.

[FIG. 10]

FIG. 10 is a cross sectional view showing main components of a flat fuel cell disclosed in Patent Document 1.

[DESCRIPTION OF REFERENCE NUMERALS]

10: fuel cell stack, 12: casing, 14: cell unit,

16: MEA unit, 17a, 17b: separator,

22: solid polymer electrolyte membrane,

24(1) to 24(n: membrane electrode assemblies,

28: cathode, 30: anode, 53a, 53b: seal member,

72: guide groove, 74a: coolant supply passage,

747b: coolant supply passage, 76a: coolant inlet,

76b: coolant outlet, 80a, 80b: spacer

FIG. 1

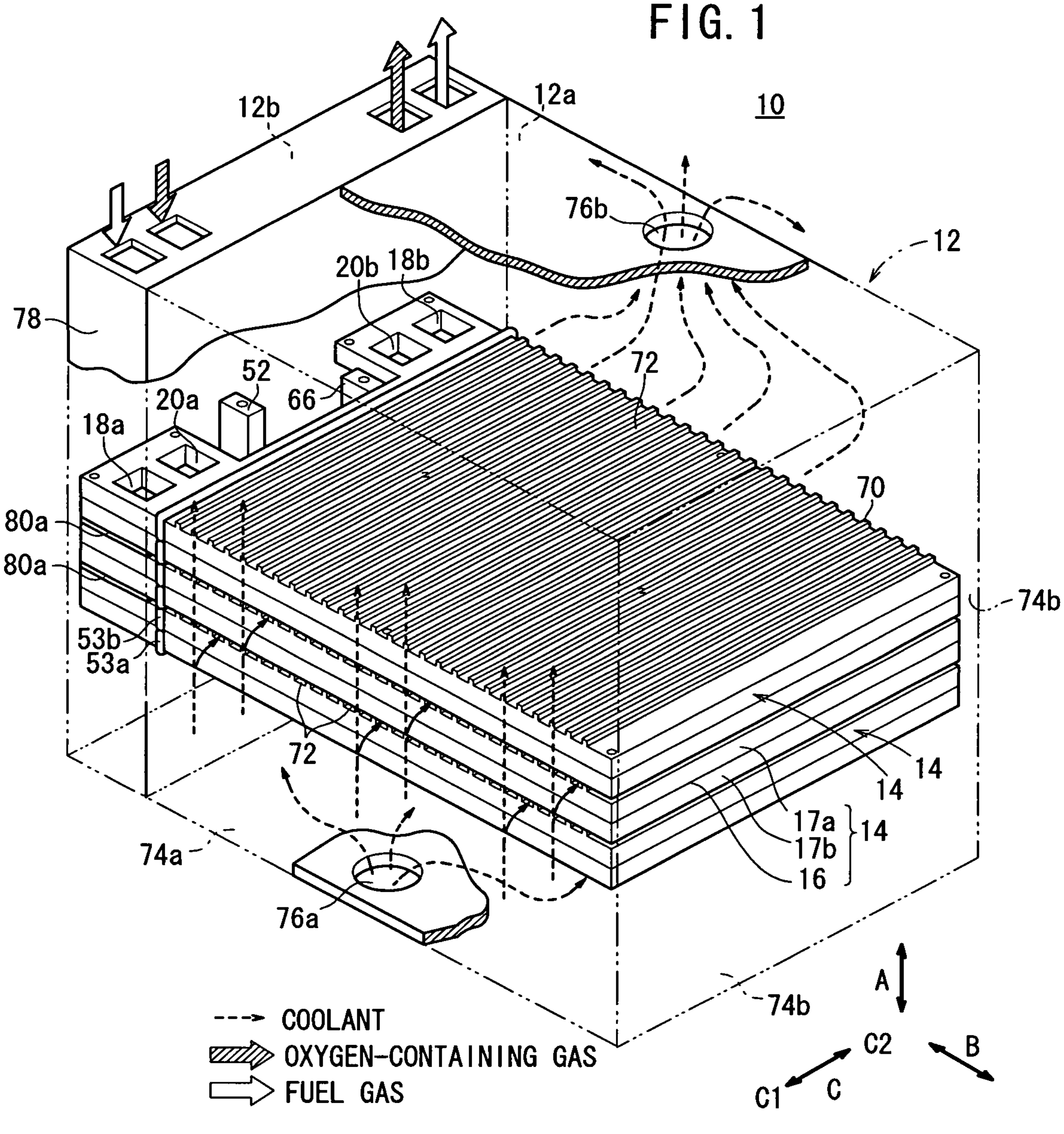
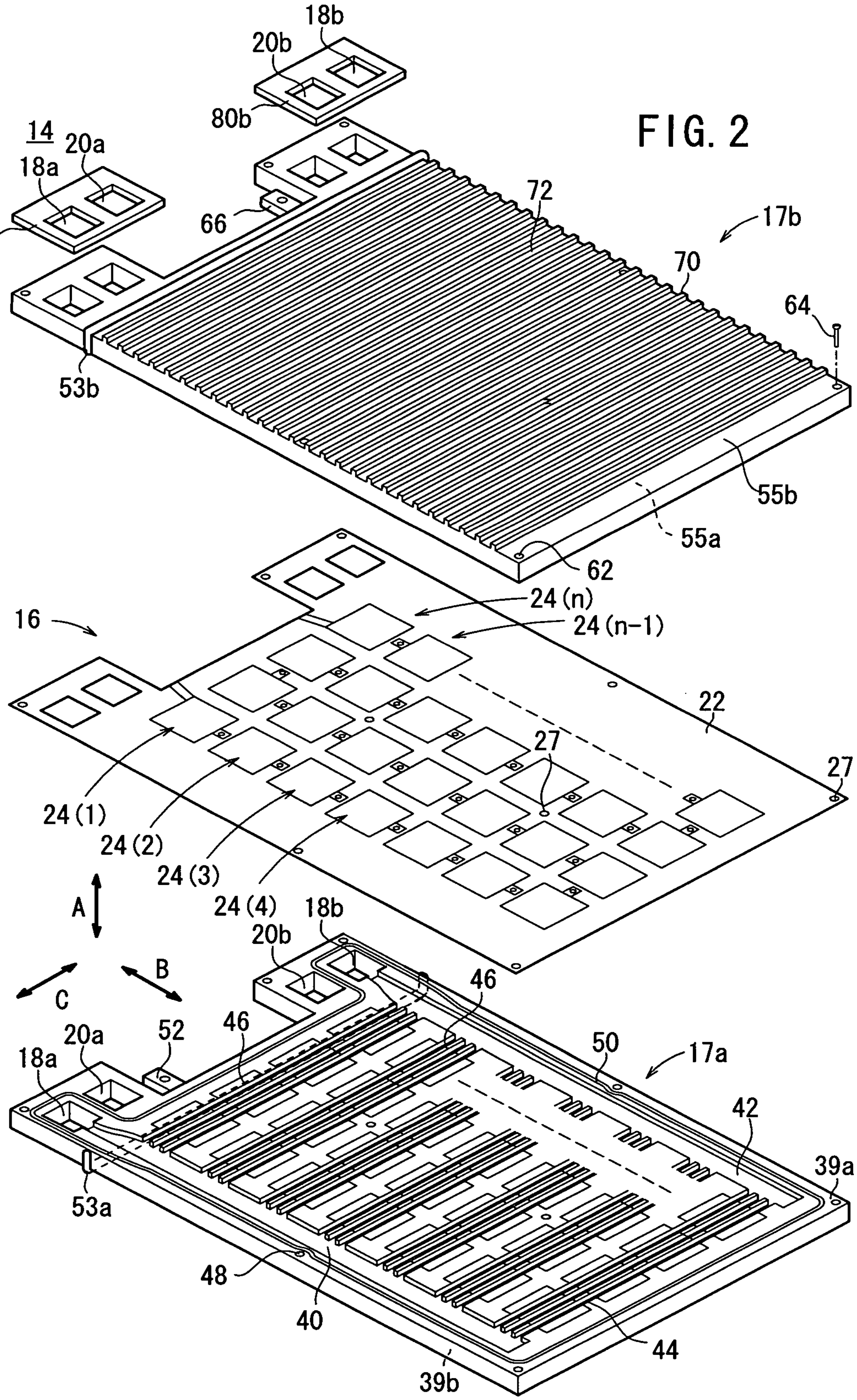

10
12b
12a
76b
12
20b
18b
78
72
52
20a
66
18a
70
80a
80a
74b
53b
53a
72
14
14
14
17a
17b
16
74a
76a
A
74b
C2
B
C1
C
COOLANT
OXYGEN-CONTAINING GAS
FUEL GAS

FIG. 2



14
18a
20a
80a
18b
20b
80b
66
72
17b
70
64
53b
55b
55a
62
16
24 (n)
24 (n−1)
22
27
27
24 (1)
24 (2)
24 (3)
24 (4)
A
B
C
18b
20b
46
46
52
20a
18a
50
17a
42
39a
53a
48
40
44
39b

FIG. 3

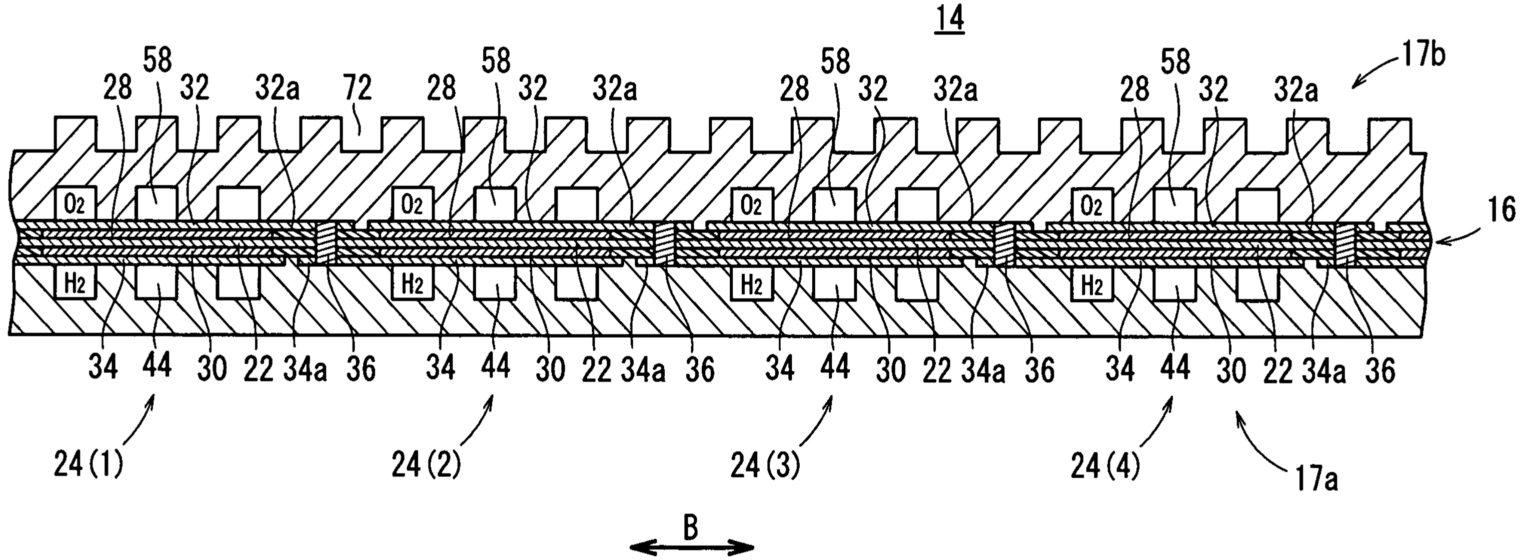
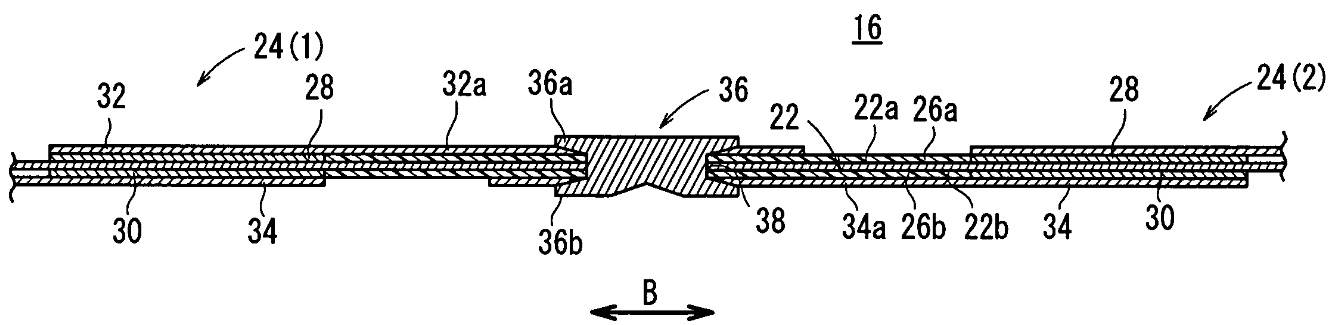

14
17b
16
17a
28
58
32
32a
72
O_2
H_2
34
44
30
22
34a
36
24(1)
24(2)
24(3)
24(4)
B

FIG. 4



16
24(1)
32
28
32a
36a
36
22
22a
26a
28
24(2)
30
34
36b
38
34a
26b
22b
34
30
B

FIG. 5

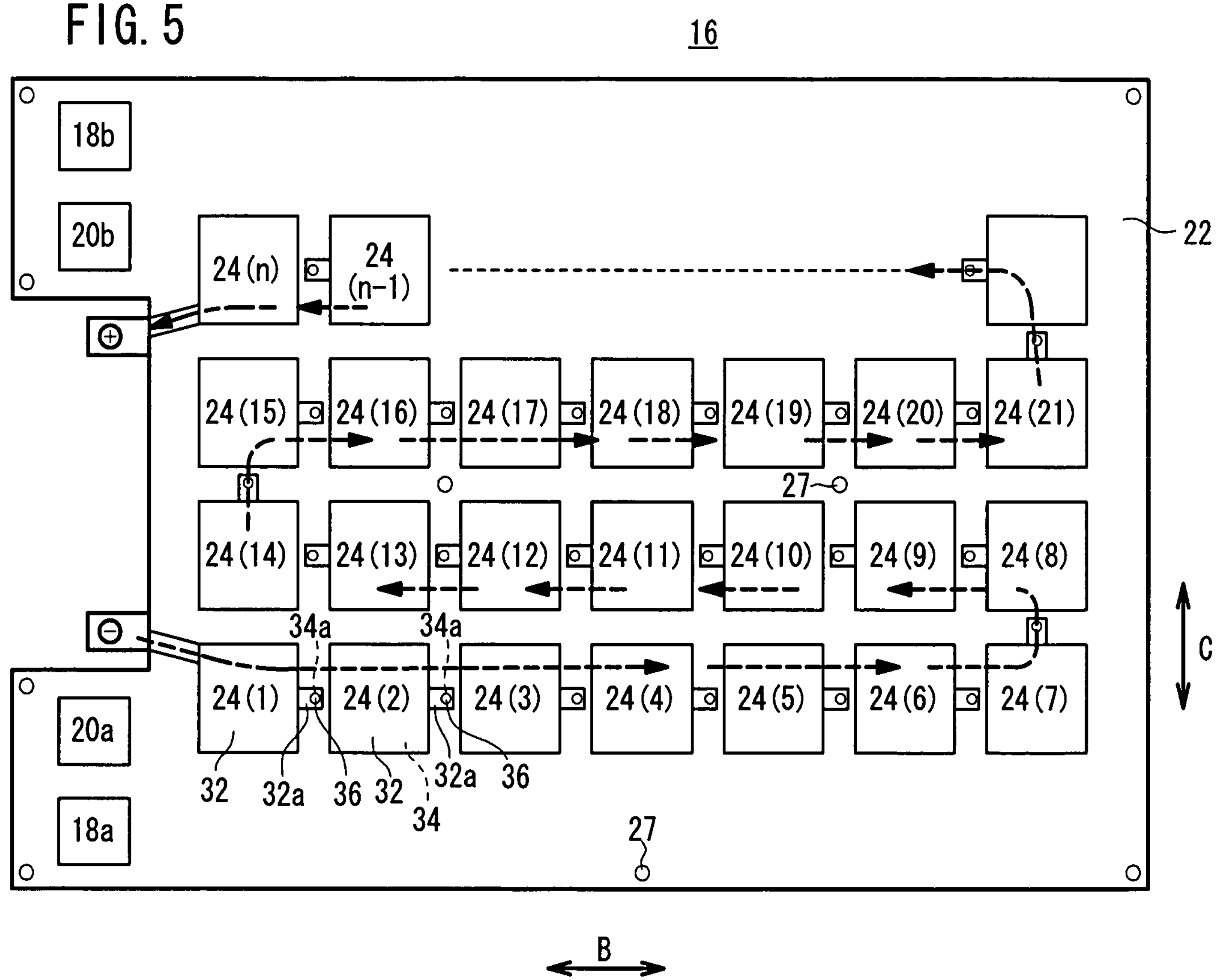

16
18b
20b
24 (n)
24 (n-1)
22
24 (15)
24 (16)
24 (17)
24 (18)
24 (19)
24 (20)
24 (21)
27
24 (14)
24 (13)
24 (12)
24 (11)
24 (10)
24 (9)
24 (8)
34a
34a
24 (1)
24 (2)
24 (3)
24 (4)
24 (5)
24 (6)
24 (7)
C
20a
18a
32
32a
36
32
32a
36
34
27
B

FIG. 6

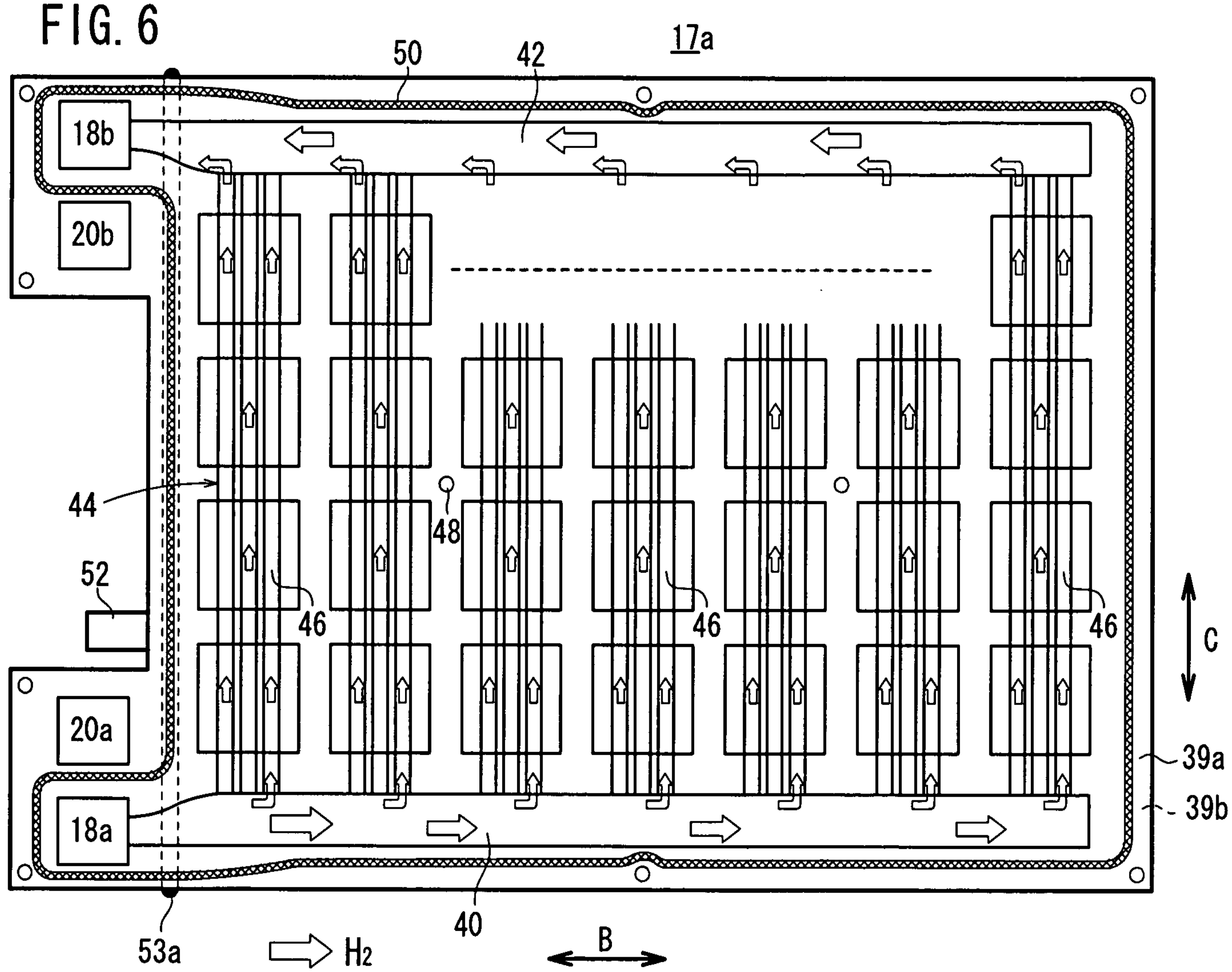


FIG. 7

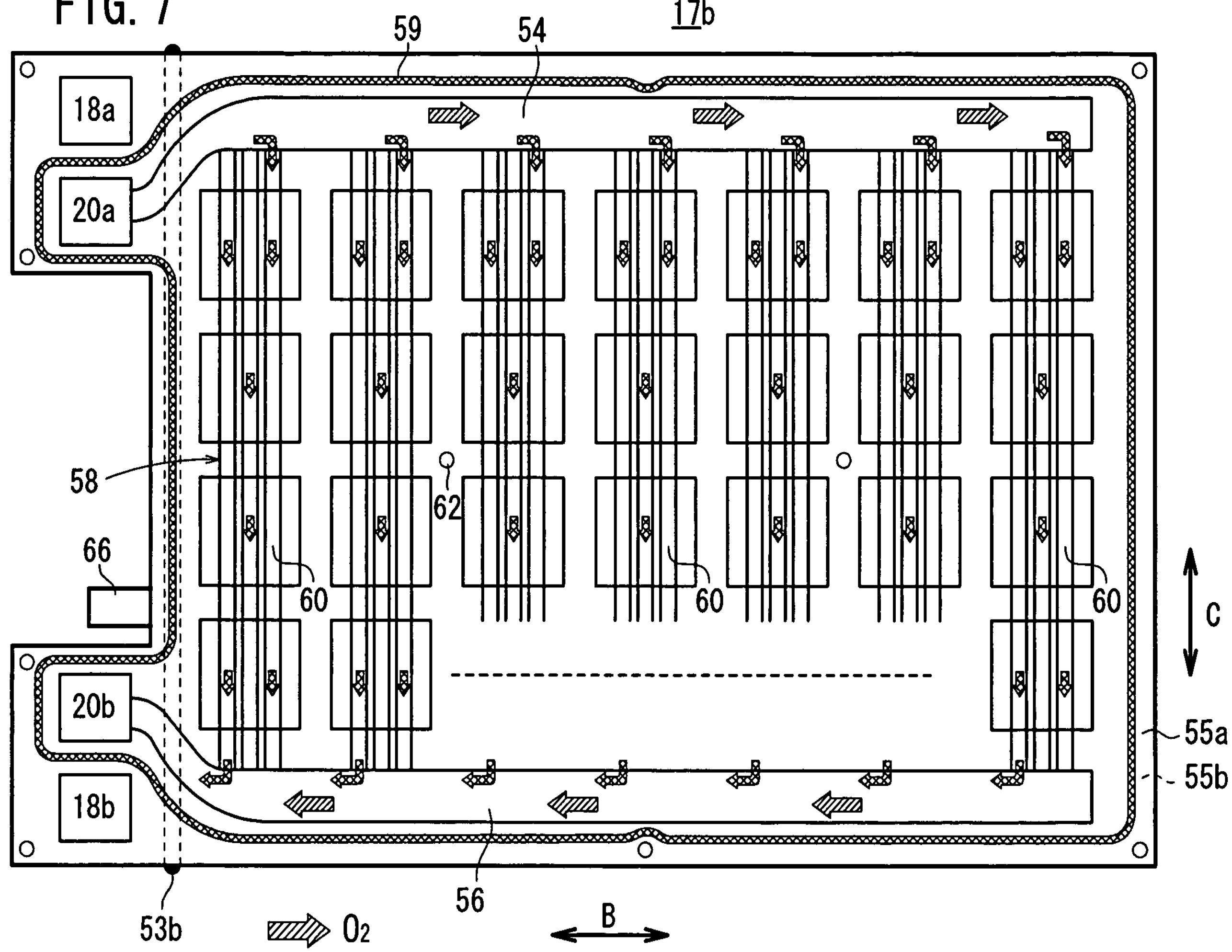


FIG. 8

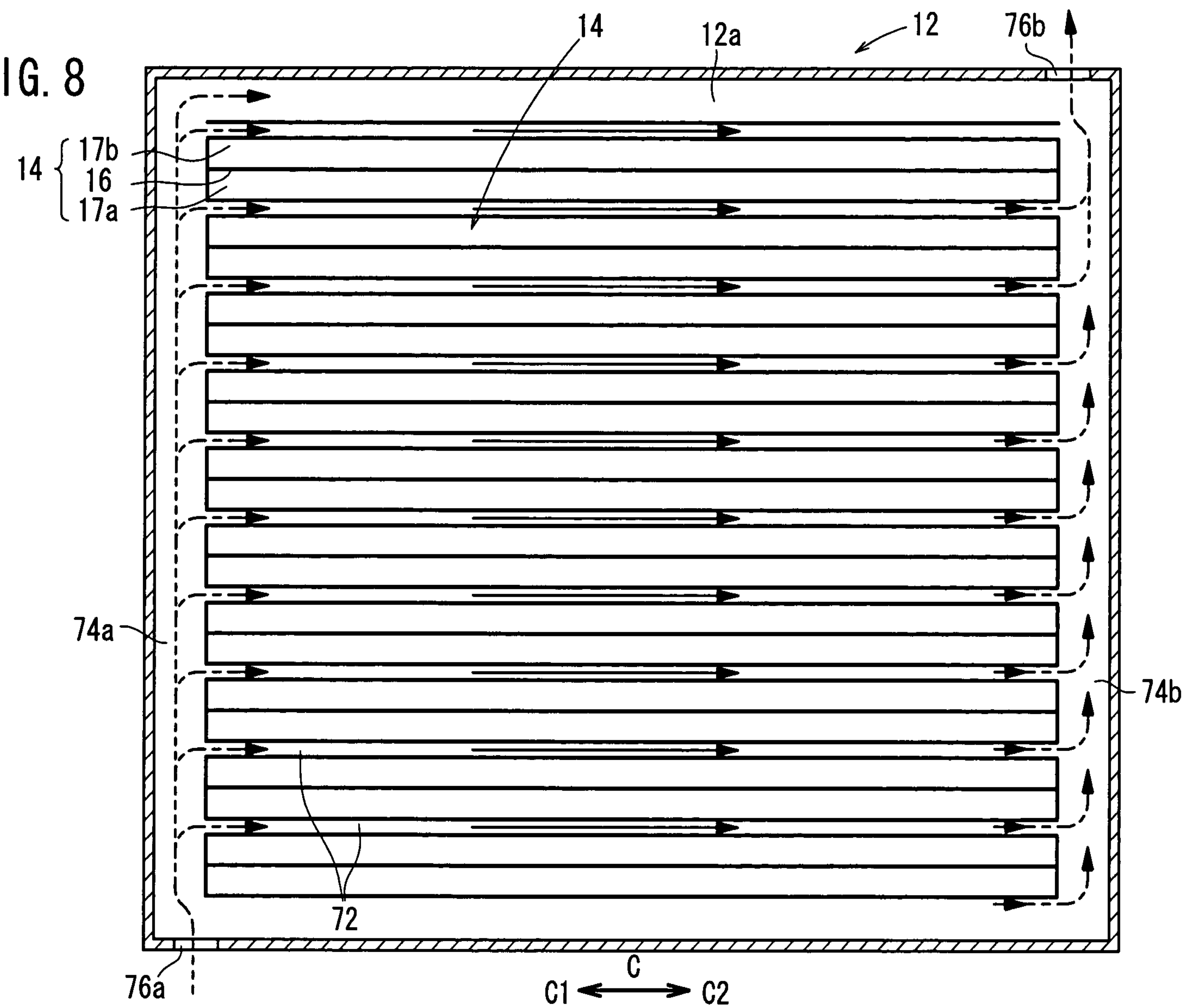


FIG. 9

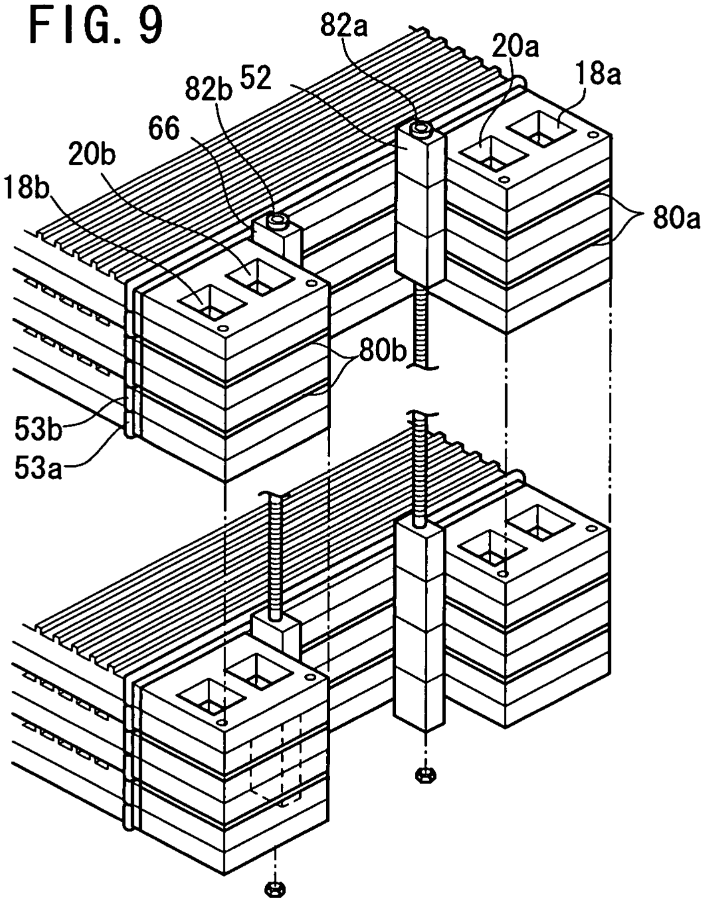
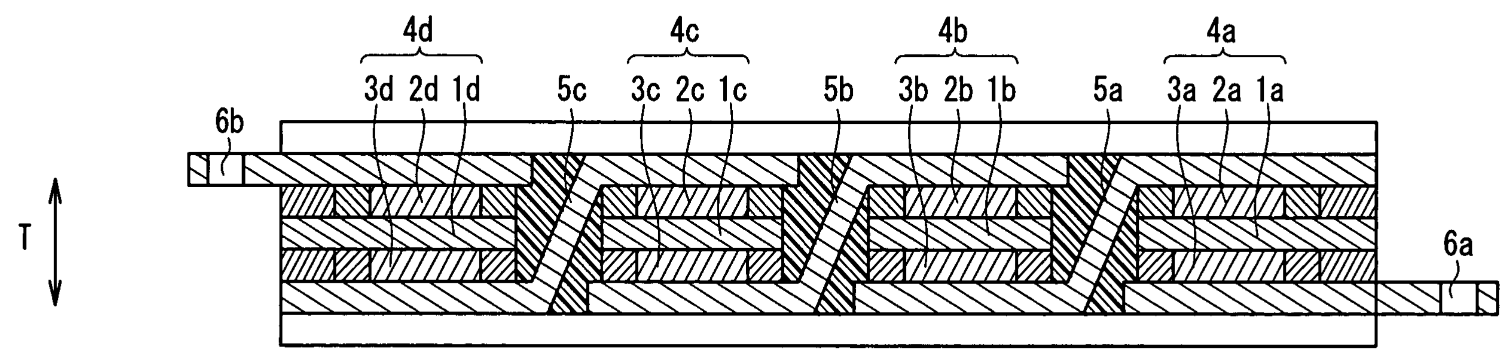


FIG. 10



[DOCUMENT NAME] Abstract

[ABSTRACT]

[TASK] To provide a fuel cell stack having a simple and compact structure in which a plurality of power generation units are arranged in the same plane to form a cell unit for producing a large output while suitably cooling the power generation units.

[SOLUTION] a casing 12 accommodates a plurality of cell units 14 stacked in a direction indicated by the arrow A. The cell unit 14 comprises an MEA unit 16, insulated first and second separators 17a, 17b interposing the MEA unit 16. The second separator 17b comprises guide grooves 72 for flowing a coolant along the surface thereof. By accommodating the stacked cell units 14 in the casing 12, a coolant supply passage 74a and a coolant supply passage 74b being integrally connected to the guide grooves 72 of the cell units 14 are formed.

[SELECTED FIGURE] FIG. 1